SURFACE CHEMISTRY

1. **Adsorption.** It is the phenomenon of higher concentration of molecules of gases or liquid on the surface than in the bulk of the solid.
2. **Types of adsorption**
   (*i*) Physical adsorption
   (*ii*) Chemical adsorption
3. **Types of solutions**
   (*i*) True solutions
   (*ii*) Colloidal solutions
   (*iii*) Suspensions
4. **Types of colloids**
   (*i*) Lyophillic colloids
   (*ii*) Lyophobic colloids
5. **Coagulation.** It is the phenomenon of precipitiation of a colloidal solution by the addition of excess of an electrolyte.
6. **Emulsions.** These are the colloidal solutions of two immiscible liquids.

7. **Gel.** It is the colloidal solution of a liquid in a solid.
8. **Dialysis:** In this method, the colloidal solution is taken in a bag made of cellophane or parchment paper and is suspended in fresh water. The impurities diffuse out of the bag leaving behind pure colloidal solution in the bag.
9. **Ultrafiltration:** In this process impurities from colloidal solution are removed by passing it through ultrafilter papers.
10. **Sorption** is the phenomenon in which adsorption and absorption occur together.
11. Physical adsorption is also called as **physisorption** and chemical adsorption is also called as **chemisorption**.
12. The reverse process of adsorption is called as **desorption**.
13. Adsorption is accompanied with evolution of heat, whereas desorption takes place with absorption of heat.
14. A lyophillic sol in which the dispersion medium is water, is called as **hydrophillic sol** or **emulsoid**.

15. A lyphobic sol in which the dispersion medium is water, is called as **hydrophobic sol** or **suspensoid**.
16. Gold sol obtained by the reduction of $AuCl_3$ by $SnCl_2$ in purple in colour and is called as **purple of cassius**.
17. The process of breaking an emulsion to get two immiscible liquids is called as **demulisification**.
18. Heterogeneous catalysis is also called as **surface catalysis**.

Distinction Between Adsorption and Absorption

	Adsorption		Absorption
I.	The concentration of adsorbate is higher on the surface of adsorbent.	I.	The concentration of gas or liquid particles is uniform throughout the substance.
II.	The rate of adsorption decreases slowly as the process proceeds.	II.	Absorption rate remains uniform . throughout.
III.	It is a surface phenomenon.	III.	It is a bulk phenomenon.

Types of Adsorption

The two types of adsorption are, (i) physical adsorption and (ii) chemical adsorption.

Distinction between physical and chemical adsoptions

	Physical adsorption		Chemical adsortion
I.	Adsorbate is held with adsorbent by Vander Waal's forces.	I.	Adsorbate are held with adsorbent by strong chemical forces.
II.	It forms multimolecular layers.	II.	It forms monomolecular layers.
III.	It takes place at low temperature.	III.	It takes place at high temperature.
IV.	Adsorption rate increases with increase in pressure of adsorbate.	IV.	Adsorption rate decreases with increase in pressure of adsorbate.
V.	It is reversible.	V.	It is irreversible.
VI.	It is not specific.	VI.	It is very specific.
VII.	Heat of adsorption is 20-40 kJ mol^{-1}.	VII.	Heat of adsorption is more than 40 kJ mol^{-1}.

Adsorption of Gases on Solids

The extent of adsorption of a gas on a solid depends upon the following factors:

I. **Nature of the gas:** The easily liquifiable gases are adsorbed to a greater extent than the permanent gases.

II. **Nature of the adsorbent:** Different adsorbents adsorb different gases upto different extent.

III. **Temperature of the system:** Generally, adsorption decreases with the increase in the temperature of the system.

IV. **Pressure of the gas:** Generally, adsorption increases with the increase of the pressure of the gas.

V. Activation of the adsorbent: Solids can be activated by different methods to increase their adsorption powers. This is done by increasing their surface area.

Types of Solutions: Colloidal Solutions

On the basis of particle size of the substance, the solutions may by classiffied into three types:

(a) True solutions

(b) Colloidal solutions and

(c) Suspensions

Emulsions

Emulsions are the colloidal solutions of two immiscible liquids. Emulsions are stabilized by additon of emulsifying agents such as soaps, gum, lyophillic colloids etc. The two types of emulsions are:

I. Oil-in-water type (O/W): Oil is the dispersed phase and water is the dispersion medium. e.g. milk, cream etc.

II. Water-in-oil type (W/O): Water is the dispersed phase and oil is the dispersion medium. Such as butter, cold cream etc.

Applications of Emulsions

I. The concentration of sulphide ore in presence of pine oil by froth floatation process.

II. Digestion of fats in the intestines.

III. Several drugs are available in the form of emulsions.

IV. In cosmetics like creams, lotions and ointments.
V. The cleansing action of soaps and detergents.
VI. Milk is fat-in-oil type emulsion.

Micelles and Cleansing Action of Soaps

Some substances act as electrolytes either at low concentration or at high concentration tend to associate and form aggregated particles which are called as micelles. Such as soaps and detergents. The cleansing action of soap is due to its ability to act as micelle. Soaps are sodium salts of higher fatty acids, such as sodium stearate, $CH_3(CH_2)_{16}COO^-Na^+$. The carboxylic anion COO^- is known as head and it is water soluble. The long chain of alkyl group is called as tail and it is oil soluble. This tail dissolves in the grease deposit (dirt) and form micelle. Which are removed by rinsing with water.

Catalysis

A catalyst is a substance which changes the rate of a chemical reaction without taking share in the reaction. Catalysis is the phenomenon of

changing the rate of a reaction with the use of a catalyst. Catalysis are of two types:

I. **Homogeneous catalysis:** When catalyst,reactants and products are in the same phase.

(a) SO_2 is oxidized to SO_3 in presence of nitric oxide.

$$2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$$

(b) Ester hydrolysis:

$$\underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5(l)} + H_2O(l) \xrightarrow{H^+(aq)} \underset{\text{Ethanoic acid}}{CH_3COOH(l)} + \underset{\text{Ethanol}}{C_2H_5OH(l)}$$

II. **Heterogeneous catalysis:** When catalyst is in different phase to that of reactants. It is a surface phenomenon.

(a) In contact process of manufacture of SO_3 in presence of V_2O_5.

$$\underset{\text{sulphure dioxide}}{2SO_2(g)} + \underset{\text{Oxygen}}{O_2(g)} \xrightarrow{V_2O_5(s)} \underset{\text{Sulphur trioxide}}{2SO_3(g)}$$

(b) Synthesis of CH_3OH from CO and H_2 using ZnO + CuO as catalyst.

(c) In Haber's process of manufacture of NH_3 in presence of Fe catalyst.

$$\underset{\text{Nitrogen}}{N_2(g)} + \underset{\text{Hydrogen}}{3H_2(g)} \xrightarrow{Fe(s)} \underset{\text{Ammonia}}{2NH_3(g)}$$
